

What is Claimed Is:

1. A process for manufacturing a chiral amine, the process comprising:
admixing (i) a ketone, (ii) an amine, (iii) an acid, and (iv) a catalyst, which comprises a transition metal complexed with a chiral phosphine ligand; and
exposing the admixture to a source of hydrogen to reductively aminate the ketone with the amine to form a chiral amine product.
2. The process of claim 1, wherein the acid is a Lewis acid.
3. The process of claim 1, wherein the ketone, amine, acid, and catalyst are in a medium buffered to a pH of about 3.5 to about 6.5.
4. The process of claim 1, wherein the transition metal is selected from the group consisting of rhodium, iridium, ruthenium, palladium and combinations thereof.
5. The process of claim 2, wherein the Lewis acid is selected from the group consisting of: $\text{Ti}(\text{OR})_4$, TiCl_4 , $\text{Zn}(\text{OTf})_2$, ZnCl_2 , $\text{Al}(\text{OR})_3$, MgSO_4 , BF_3 , $\text{B}(\text{C}_6\text{F}_5)_3$, $\text{La}(\text{OR})_3$, $\text{La}(\text{OTf})_3$ and $\text{Cu}(\text{OTf})_2$; wherein R is an alkyl or aryl group and OTf is a triflate group.
6. The process of claim 1, wherein the transition metal is in the form of a salt or complex selected from the group consisting of: $(\text{Rh}(\text{COD})\text{Cl})_2$; $(\text{Rh}(\text{COD})_2)\text{X}$; $(\text{Ir}(\text{COD})\text{Cl})_2$; $(\text{Ir}(\text{COD})_2)\text{X}$; $(\text{Ir}(\text{COD})\text{I})_2$; $(\text{Rh}(\text{NBD})\text{Cl})_2$; $(\text{Rh}(\text{NBD})_2)\text{X}$; $(\text{Ir}(\text{NBD})\text{Cl})_2$; $(\text{Ir}(\text{NBD})_2)\text{X}$; $(\text{Ir}(\text{NBD})\text{I})_2$; $\text{Ru}(\text{RCOO})_2(\text{diphosphine})$; $\text{RuX}'_2(\text{diphosphine})(\text{DMF})_n$; $(\text{NH}_2\text{R}_2)\{\text{RuCl}(\text{bisphos})_2(\text{Cl})_3\}$, $\text{Ru}(\text{methallyl})_2(\text{diphosphine})$; $\text{Ru}(\text{aryl group})\text{X}'_2(\text{diphosphine})$, $\text{RuCl}_2(\text{bisphosphine})(\text{diamine})$; wherein COD is a 1,5-

cyclooctadiene, NBD is a norbornadiene, DMF is a dimethylformamide, R is alkyl or aryl, X is BF₄, ClO₄, SbF₆ or CF₃SO₃, X' is Cl or Br and n indicates a salvation state.

7. The process of claim 4, wherein the diphosphine is selected from the group consisting of: DuPhos, BINAP, BPPM, DIPAMP, DIOP, MCCPM, BCPM, BICP, PennPhos, BPE, ChiraPhos, NorPhos, Degphos, BPPFA, JosiPhos, TRAP, TolBINAP, H8-BINAP, BINAPO, MOP, BINAPHOS, BIPHEMP, SEGPPOS, TUNAPHOS, KetalPhos, f-KetalPhos, HydroPhos, f-HydroPhos, Binaphane, f-Binaphane, Ferrotane, Walphos, Rophos, Butiphane phanephos, Madyphos, Taniaphos, Malphos, Cl-MeO-BIPHEP, BIPFUP, P-phos, JAFaphos, Spirop, MeO-BIPHEP, and Bophoz.

8. The process of claim 1, wherein the chiral phosphine ligand is f-Binaphane.

9. The process of claim 1, wherein the catalyst is formed *in situ* by mixing a transition metal salt or transition metal complex with the chiral phosphine ligand.

10. A process for manufacturing a chiral aryl amine, the process comprising:

admixing (i) an aryl ketone, (ii) an amine, (iii) an acid, and (iv) a catalyst, which comprises a transition metal complexed with a chiral phosphine ligand; and

exposing the admixture to a source of hydrogen to reductively aminate the aryl ketone with the amine to form a chiral aryl amine product.

11. The process of claim 10, wherein the transition metal is a group VIII transition metal and combinations thereof.

12. The process of claim 10, wherein the acid is selected from the group consisting of: $\text{Ti}(\text{OR})_4$, TiCl_4 , $\text{Zn}(\text{OTf})_2$, ZnCl_2 , $\text{Al}(\text{OR})_3$, MgSO_4 , BF_3 , $\text{B}(\text{C}_6\text{F}_5)_3$, $\text{La}(\text{OR})_3$, $\text{La}(\text{OTf})_3$ and $\text{Cu}(\text{OTf})_2$; wherein R is an alkyl or aryl group and OTf is a triflate group.

13. The process of claim 10, further admixing iodine with the aryl ketone, amine, acid, and catalyst prior to exposing the admixture to the source of hydrogen.

14. The process of claim 10, wherein the chiral phosphine ligand is selected from the group consisting of: DuPhos, BINAP, BPPM, DIPAMP, DIOP, MCCPM, BCPM, BICP, PennPhos, BPE, ChiraPhos, NorPhos, Degphos, BPPFA, JosiPhos, TRAP, TolBINAP, H8-BINAP, BINAPO, MOP, BINAPHOS, BIPHEMP, SEGPHOS, TUNAPHOS, KetalPhos, f-KetalPhos, HydroPhos, f-HydroPhos, Binaphane, f-Binaphane, Ferrotane, Walphos, Rophos, Butiphane phanephos, Madyphos, Taniaphos, Malphos, Cl-MeO-BIPHEP, BIPFUP, P-phos, JAFaphos, Spirop, MeO-BIPHEP, and Bophoz.

15. A process for manufacturing a primary amine chiral compound, the process comprising:

admixing (i) an aryl ketone, (ii) an amine having a leaving group, (iii) a Lewis acid, and (iv) a catalyst, which comprises a transition metal complexed with a chiral phosphine ligand;

exposing the admixture to a source of hydrogen to reductively aminate the aryl ketone with the amine having the leaving group to form a chiral compound having the amine with the leaving group; and

removing the leaving group from the amine to form a primary amine chiral compound.

16. The process of claim 15, further admixing iodine with the aryl ketone, amine, acid, and catalyst prior to exposing the admixture to the source of hydrogen.

17. The process of claim 16, wherein the chiral phosphine ligand is f-Binaphane.

18. A composition comprising (i) an aryl ketone, (ii) an amine, (iii) a Lewis acid, (iv) iodine, and (v) a catalyst, which comprises a group VIII transition metal complexed with a chiral phosphine ligand.

19. The composition of claim 18 wherein the chiral phosphine ligand is f-Binaphane.